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☐ 1. Document ID: NN8808428

L7: Entry 1 of 1 File: TDBD Aug 1, 1988

DOCUMENT-IDENTIFIER: NN8808428
TITLE: Automobile Electronics Test Diagnostic Instrument and Communications Circuit

TBTX:
- This article describes test diagnostic instrumentation and a communications circuit therefor that can be applied to an automotive display system and most other automotive control units. Automotive electronics designers are using numerous microprocessor-based electronic units in automobiles, trucks, buses, etc., to provide control functions related to the engine, body controls, air conditioning and ventilation, remote radio and entertainment, mobile telephones, maintenance logging, navigation, etc. A microprocessor- based display system is frequently an integral part of these systems providing the control center for the driver/operator to input commands and monitor operation. Testing the display system requires duplicating or simulating the various other electronic assemblies and the operator. Of course, equipment can vary with the application and conditions. Traditionally, many types of tests are involved during a product's life cycle, including tests associated with hardware and code development, unit qualification, manufacturing, auto assembly and field service. This article describes a test diagnostic instrument (TDI) that will be applied to many of these tests and a communications interface that will be used to simulate electronic assemblies with which the device under test (DUT) will communicate with via a bus protocol. Although the article covers testing a display system, the test set and concepts can be applied to most automotive control units, singularly or in combination. ***** SEE ORIGINAL DOCUMENT ***** Fig. 1 shows the TDI setup, simplified, for testing a typical automotive display system. TDI 1 simulates the ignition switch and various electronic assemblies via a cable harness. The devices under test (DUTs) are display controller 2 and the display monitor 3. Fig. 2 shows the TDI setup in detail. The TDI 1 is a personal computer (PC)-based test system that contains several unique interface cards or functions as follows: Touch bezel simulator 4 optionally, if used, provides a matrix of signals that simulate the operator touching the touch-sensitive screen on the front of the display. This connection would typically be used when testing the display controller during development, manufacture or qualification. Power sequence simulator 5 simulates the ignition switch and signals generated when opening and closing doors. The ignition switch functions can be custom tailored by software to simulate a specific ignition switch's electrical characteristics. ***** SEE ORIGINAL DOCUMENT ***** Control bus, entertainment and comfort (E&C) bus simulator 6 simulates equipment normally connected to the display system via bus networks, such as a standard serial universal asynchronous receiver/transmitter (UART) bus. This typically includes the engine control unit, body control unit, radio, climate control unit, cellular phone, etc. Miscellaneous I/O simulator 7 provides unique discrete and analog inputs and outputs as required. IEEE-488 bus interface 8 drives special support test equipment. Specifically, a programmable power supply 9 permits varying simulated battery voltage. A logic analyzer 10 permits testing video without direct human observation. Fig. 3 illustrates the software partitioning for the TDI. The executive establishes the operating modes (e.g., immediate or sequential, test or development). The executive also handles routine calls and determines how data is to be displayed and stored. Subroutines are set up to develop and handle vehicle personalization (generation of signals which are vehicle specific), modes, and data and signal

processing. Fig. 4 shows the communications circuit on the communications card in block diagram. The communications card will connect to the PC as a specialized adapter card via one of its expansion slots. This will allow the user to configure the system via software controls from the PC keyboard. For example, a user might want to keep a log of all error sequences which might occur while communicating with the DUT. The user would do this by writing specific applications software to communicate with the adapter card via the PC Bus 13. The adapter bus would then generate the appropriate signals to communicate across the specified bus. The adapter card would contain specialized microcode to support the specific user application. ***** SEE ORIGINAL DOCUMENT ***** A UART 11 provides the interface to a custom UART bus 12 by functioning as an asynchronous communications element. This element performs parallel-to-serial conversion on data bytes received from the PC Bus 13 and sends the serialized data out on the UART bus 12. The purpose is to simulate equipment normally connected to the display system via this custom UART bus, such as an engine control unit or a body control unit. A microcontroller 14 with its accompanying RAM 15 and ROM 16 is used to provide communications across another data link which is a software-driven custom serial bus 17. Also, included in this microcontroller is a UART which can handle the communications function performed by the separate UART 11. Using an independent UART instead of the on-board microcontroller UART lets the user control the UART bus totally by the PC software, thereby enhancing flexibility of programming. This bus provides for E&C functions that require operator-induced type messages. For example, the communications card could emulate a radio, a climate control unit or even a cellular telephone across the serial bus to a CRT controller. The circuit is especially useful for its flexibility when designing external circuits that will integrate with other devices via an external bus. It is capable of emulating devices that would normally be connected to the bus but cannot be because of testing constraints.

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